



Raising awareness of climate change causes? Cross-national evidence for the normalization of societal risk perception of climate change



Sílvia Luís*, Christin-Melanie Vauclair, Maria Luísa Lima

Instituto Universitário de Lisboa (ISCTE-IUL), CIS-IUL, Lisboa, Portugal

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ABSTRACT

Increasing the awareness of climate change causes is often considered the key to public support of mitigation and adaptation policies. However, higher awareness might not always relate to higher risk perceptions. Previous research suggests that a process of risk normalization might occur, wherein individuals more exposed and aware of hazards minimize their risk perception to psychologically cope with hazards. This study elaborates on and expands this research, by conducting multilevel analyses on more recent data from the International Social Survey Programme from 33 countries ($N = 46,221$). Results show that in countries with higher carbon dioxide emissions, where people are more exposed to the activities and technologies related to climate change, individuals tend to have lower societal risk perceptions of climate change due to their higher awareness of climate change causes. New insight is provided, as results confirm this effect of risk normalization after controlling for the country socioeconomic context and individual-level covariates (gender, age, education, political orientation, place of living). Of most relevance, results further illustrate that this effect is moderated by the environmental concern of individuals.

1. Introduction

Policymakers are being faced with the challenge of developing both policies to mitigate climate change effects, especially by reducing greenhouse gas emissions, and policies to adapt to the inevitable impacts of climate change. However, mitigation and adaptation to climate change factors will hardly be achieved without public support and engagement. A considerable body of research suggests that risk perception influences public support and public engagement regarding climate change initiatives (e.g., Hagen et al., 2016). Yet the relations between climate change awareness and risk perception are not entirely clear. Higher awareness of climate change might relate to lower risk perception of climate change due to a process of risk normalization. This line of thought, although counterintuitive, is not new. For instance, Norgaard (2011) study of attitudes towards climate change illustrates a disjuncture between the collectively constructed sense of normal everyday life and the troubling knowledge of climate change, arguing that this topic is denied in order to avoid feelings of fear, guilt and helplessness. The objective of this study is to contribute to the understanding of the process of risk normalization, i.e., the psychological process of risk minimization or banalization as a way to deal with a known threat. For this purpose, we will analyse the relation between climate change hazard (indicated by carbon dioxide emissions – CO₂)

and individuals' perception of societal climate change risk (in particular environmental risk), and the mediator role of awareness of climate change causes.

1.1. Risk normalization

Existing literature on risk perception shows that a continued awareness and experience of threatening situations leads to the development of strategies that minimize the perceived risk, as a way to psychologically cope with the threat (Lima, 2004; Lima et al., 2005; Luís et al., 2016; Parkhill et al., 2010). When individuals experience a threat, they tend to cope and eventually become used to its presence, which results in a negative association between the presence and awareness of a hazard and an individual's risk perception. This psychological effect has been coined as *risk perception normalization*. Risk perception normalization is particularly likely to occur when risks have less tangible consequences (Barnett and Breakwell, 2001), as is the case of global environmental problems, which consequences are often perceived as distant in space and time (Schultz et al., 2014; Spence et al., 2012). Therefore, societal risk perception of climate change might be especially prone to this normalization effect. Lima and colleagues (2005) provided some evidence of its occurrence. Analysing archival data from 2000 collected in 25 countries, they showed that indicators of

* Corresponding author at: Instituto Universitário de Lisboa (ISCTE-IUL), Edifício ISCTE, CIS-IUL, Avenida das Forças Armadas, 1649-026 Lisboa, Portugal.
E-mail address: silvia_luis@iscte-iul.pt (S. Luís).

technological prevalence (such as CO₂ emissions and chemicals use in farming) were related to lower risk perception, and that this relation was mediated by awareness about different hazards related to those technologies. Higher technological prevalence led to the increase of awareness about environmental hazards likely due to developments in policy and risk management. This increase in awareness then related to a reduction of the perceived risks associated with those technologies (such as climate change and pollution due to chemicals use in farming). Individuals appear to develop psychological risk minimization strategies as a way to minimize perceived threats and psychologically adapt to the situations. However, such strategies do not contribute to solving environmental hazards.

Literature on climate change denial illustrates how the normalization process might occur. Following on Cohen's types of denial (2001), Norgaard (2011) described how people who know about climate change fail to act on that knowledge, i.e., how the psychological, political, or moral implications of that knowledge are not integrated into everyday life or transformed into social action (implicatory denial), suggesting a lack of connect between abstract information of climate change and everyday life. She also described how people might know about climate change but reinterpret that information, for instance thinking climate change is natural, or will not be that bad (interpretative denial). It has also been pointed out the influence of vested-interest groups who have carried-out misinformation campaigns, thereby contributing to deny the climate change science, undermining public understanding of the degree of scientific agreement, and the progress in policymaking (see Oreskes and Conway, 2010). In a recent review, Washington (2017) illustrated that society allows climate change denial to prosper because of a fear of change, failure in worldview, or fixation on the economy.

In this study, we aim to ascertain whether the societal risk normalization effect of climate change still holds, considering the changes that took place during the last decade. Between 2004 and 2013, global CO₂ emissions continued to grow 2.5% per year (Friedlingstein et al., 2014). Public awareness of climate change might also have increased to date. Studies have identified a near-linear relationship between global mean temperature change and cumulative CO₂ emissions (e.g., Matthews et al., 2009), leaving no room for uncertainty on the anthropogenic causes of climate change. In addition, many countries have been discussing and becoming more committed to climate change mitigation (Burck et al., 2015). Also, Lima and colleagues (2005) focused on examining a general model of environmental hazards, environmental awareness, and environmental risk perceptions. This study will focus specifically on climate change. This focus will allow us to draw more valid conclusions, when it comes to the highly-debated issue of climate change.

It should be noted that studies on the relation between knowledge of climate change and risk perception have presented mixed results. Whereas in some studies a negative relation was found (Kellstedt et al., 2008), in others no relation emerged (Brody et al., 2008), and in most studies a positive relation is actually found (O'Connor et al., 1999; Sundblad et al., 2007; van der Linden, 2015). Therefore, it is necessary to test if the negative correlation between awareness and societal risk perception that was previously found also emerges when focusing on climate change causes in particular, and to discuss possible boundaries for this effect that might explain these mixed results.

Moreover, the study by Lima and colleagues (2005) did not control for individual-level variables that might also account for environmental risk normalization effects. Hence, we will conduct a multilevel analysis on recent data, which will allow us to examine the hypothesized country-level effects, while controlling for relevant socio-demographic variables. In particular, we controlled for country-level socioeconomic context, as well as gender, age, education, political orientation, and place of living as variables that could also account for a risk normalization effect. The country's socioeconomic context has not been found to be a reliable predictor of climate change risk perception (Lee et al.,

2015). Nonetheless, its possible effect in risk perception was analysed. Research suggests that gender and political orientation have systematic effects in climate change risk perception. Females tend to have a higher risk perception than males for a wide range of hazards, including climate change (Brody et al., 2008; O'Connor et al., 1999; Sundblad et al., 2007; van der Linden, 2015), and liberals tend to have a higher degree of climate change risk perception than conservatives (Leiserowitz, 2006; van der Linden, 2015). The effects of age and education in climate change risk perception are less consistent. While some studies find evidence for distinctions on the basis of age difference, thus accounting for the fact that younger people have a higher risk perception regarding climate change (Milfont, 2012), others show no relation (Sundblad et al., 2007; van der Linden, 2015). Regarding education, studies have found that a higher education is related to a higher risk perception of climate change (van der Linden, 2015), but that it is also related to a lower risk perception (O'Connor et al., 1999), or that it has no relation to it whatsoever (Milfont, 2012). Place of living (urban vs. rural areas) has not yet been investigated, to our knowledge, but may matter when it comes to risk perception of climate change. Substantially more CO₂ emissions on a per capita level seem to be generated in urban areas (Heinonen and Junnila, 2011), and, therefore, individuals living there likely have a higher risk perception. Furthermore, most studies have been conducted in industrialised western countries; as such, it is important to explore whether these results can be generalized to other countries.

In addition, no study has ever tested any boundary conditions of climate change risk normalization effects. In this study, we will examine whether it depends on individuals' environmental concerns.

1.2. The effect of environmental concern on risk normalization

When examining environmental risk normalization of climate change, the question also arises whether this effect occurs for all people equally or whether there are variables that mitigate its occurrence. A candidate for this role might be environmental concern. Environmental concern can be defined as a general attitude towards the environment, which has positive effects on the perception and evaluation of environmental-related cognitions and on pro-environmental behaviour (Bamberg, 2003). Franzen and Vogl (2013) suggest that it gathers a cognitive component (having rational insight into the problem), an affective component (being emotionally affected by environmental degradation), and a conative component (being willing to act). Recent research found evidence across six culturally and politically diverse countries that higher levels of knowledge about the causes of climate change were related to a heightened concern about climate change (Shi et al., 2016). Therefore, it might be the case that when individuals are high in environmental concern they use ideologically motivated reasoning to process information on climate change. Ideologically motivated reasoning (Kahan, 2013) is a form of information processing that rationally promotes individuals' interests in forming and maintaining beliefs that have relevance for one's identity, such as environmental concern might have. Ideological motivated reasoning might justify that individuals high in environmental concern continue thinking, feeling or acting on climate change as a threat and do not minimize their risk perception.

In sum, the goals of this work are 1) to test whether there is a normalization effect, that is a negative relation between the countries climate change hazard (indicated by CO₂ emissions, and perceived by the individuals through the activities and technologies related to climate change) and the individual's climate change risk perceptions that is mediated by the individual's higher climate change awareness, using multilevel analyses; 2) to explore if the normalization effect can be explained by socio-demographic variables; 3) to test whether the normalization effect is still found when the individuals are highly environmentally concerned.

Table 1

Descriptive statistics of the country-specific samples and individual-level predictors used in the multilevel structural equation modelling mediation analyses (data source: (ISSP Research Group, 2012; World Bank, 2017)).

Country	N	% Female	Age (Mean)	Education (Mean, scale 0–18)	Right-wing party affiliation (Mean, scale 1–5)	Rural Place of Living (Mean, scale 1–5)	Climate Change Risk Perception (Mean, scale 1–5)	Climate Change Awareness (Mean, scale 1–4) ^a	Environmental Concern (Mean, scale 1–5)	CO ₂ emissions per capita (2010)
Argentina	1130	51.90	46.08	10.04	2.41	2.08	4.06	–	3.12	4.50
Austria	1019	52.60	45.06	11.32	3.16	2.89	3.80	2.37	3.27	8.00
Belgium	1142	52.10	49.24	12.61	3.36	3.32	3.39	–	3.24	10.00
Bulgaria	1003	57.90	51.93	11.26	2.87	2.41	3.94	–	2.88	6.00
Canada	985	51.20	54.27	13.98	3.09	2.42	3.72	–	3.50	14.70
Chile	1436	59.70	46.42	10.08	2.90	2.58	4.33	–	2.91	4.20
Croatia	1210	52.50	45.60	11.90	3.11	2.63	4.01	–	3.11	4.70
Czech Republic	1428	52.10	47.59	12.43	2.88	2.60	3.50	2.11	2.79	10.70
Denmark	1305	53.90	49.12	12.04	2.91	2.72	3.50	2.52	3.22	8.30
Finland	1211	55.00	45.84	12.70	3.13	2.92	3.51	2.80	3.47	11.50
France	2253	45.80	58.37	12.59	3.00	3.17	3.47	–	3.28	5.60
Germany	1407	52.90	49.57	11.31	2.62	2.85	3.92	2.35	3.20	9.10
Israel	1216	53.80	46.14	12.78	–	2.15	3.78	–	3.22	9.30
Japan	1307	52.10	50.50	12.61	3.39	2.94	4.14	–	3.15	9.20
Korea	1576	52.80	45.21	12.00	3.00	2.31	3.90	2.17	3.03	11.50
Latvia	1000	55.00	44.90	12.37	2.47	2.57	3.35	2.27	3.07	3.60
Lithuania	1023	66.40	51.48	12.48	2.93	2.50	3.67	2.01	2.77	4.40
Mexico	1637	56.70	41.12	10.36	3.06	2.22	4.15	1.89	3.10	3.80
New Zealand	1172	53.50	50.90	13.68	3.15	2.65	3.41	2.51	3.43	7.20
Norway	1382	50.40	48.43	13.29	2.87	2.96	3.28	–	3.42	11.70
Philippines	1200	50.00	42.57	9.00	2.90	2.88	4.01	1.75	3.22	0.90
Portugal	1022	58.20	51.60	8.22	2.36	2.89	4.06	–	3.14	5.00
Russia	1619	65.50	47.48	12.06	2.6	2.34	3.86	2.28	2.79	12.20
Slovakia	1159	60.20	46.27	12.63	2.53	3.11	3.85	1.90	2.77	6.70
Slovenia	1082	54.50	48.64	12.12	3.11	3.32	3.78	–	3.46	7.50
South Africa	3112	59.30	40.34	10.16	3.05	2.01	3.88	–	2.78	9.00
Spain	2560	50.20	48.53	10.30	2.71	3.07	4.00	2.14	3.13	5.80
Sweden	1181	53.10	49.04	12.42	2.80	2.76	3.51	–	3.23	5.60
Switzerland	1212	49.20	48.92	12.42	3.22	3.31	3.67	2.32	3.42	5.00
Taiwan	2209	49.80	44.78	11.06	–	2.55	4.11	2.27	3.33	–
Turkey	1665	54.20	40.02	7.22	3.47	2.31	4.22	1.72	3.18	4.10
United Kingdom	928	55.60	50.59	12.05	2.99	2.83	3.47	2.49	3.16	7.90
United States	1430	57.60	48.08	13.07	2.87	1.63	3.45	–	3.14	17.40
Totals	46221	54.42	47.72	11.65	2.93	2.66	3.78	2.22	3.15	7.66

^a Mplus estimates a model by a full information maximum likelihood method which means that missing values on endogenous variables are not replaced or imputed, but all available information is used to estimate the model.

2. Method

2.1. Individual-level variables

We used data from the International Social Survey Programme (ISSP), collected between 2009 and 2011, in which a set of questions on attitudes to environmental protection were included (ISSP Research Group, 2012). The data were collected either through face-to-face interviews, self-completion questionnaires, or a mix of different data collection methods in 33 countries (see Table 1), from America, Eurasia, Oceania, and South Africa. The selection method mostly followed a stratified multi-stage random sample. The samples are nearly representative of the populations residing in each country, aged 15 and over ($N = 46,221$).

2.1.1. Societal risk perception of climate change

The criterion variable was measured on a 5-point Likert scale with the question “In general, do you think that a rise in the world’s temperature caused by climate change is... extremely dangerous for the environment?” (1), “very dangerous” (2), “somewhat dangerous” (3), “not very dangerous” (4), “or, not dangerous at all for the environment?” (5). The item was recoded for our purposes, so that higher scores would indicate greater risk perception.

2.1.2. Awareness of climate change causes

This mediator variable was measured by the question “In your opinion, how true is this: ‘Climate change is caused by a hole in the

earth’s atmosphere”, followed by the response options “definitely true” (1), “probably true” (2), “probably not true” (3), “definitely not true” (4). Note that this item states a fact that is false. Hence, individuals who score higher on this item correctly recognize that it is not true, and therefore have a greater awareness of climate change.

2.1.3. Environmental concern

This moderator variable was measured by an environmental concern scale composed of 9 items tapping into its cognitive, affective, and behavioural aspects. Respondents indicated their agreement or disagreement with these items on a 5-point Likert scale — e.g., “People worry too much about human progress harming the environment”—recoded so that higher scores indicate greater environmental concern. The psychometric properties of this scale have been analysed and discussed by Franzen and Vogl (2013). For our analyses, we split the data into those responses that fall into the 25th (low environmental concern) and 75th (high environmental concern) percentile points.

2.1.4. Socio-demographics

We also used socio-demographic measures from the ISSP to adjust for relevant individual-level covariates when estimating country-level effects: gender (1 = “male”, 2 = “female”), age, education in years (ranging from 0 = “no formal schooling, no years at school” to 18 = “18 years”), and political orientation (1 = far left, communist etc. to 5 = far right, fascist, etc.). For explorative purposes, we also controlled for place of living (1 = “a big city”, 2 = “the suburbs or outskirts of a big city”, 3 = “a town or small city”, 4 = “a country

village”, 5 = “a farm or home in the country).

2.2. Country-level variables

CO₂ produced through human activities is the primary source of emission of greenhouse gases. For this reason, the production of CO₂ is often used as an objective indicator of global warming. In this paper, a country's per capita production of CO₂, as published by the World Bank, was used (metric tons per capita values). According to the World Bank (World Bank, n.d.), this indicator covers those CO₂ emissions that occur from burning fossil fuels and the manufacturing of cement, as well as from human consumption of solid, liquid, and gas fuels. Data from 2010 was used to match the time when the surveys took place in different countries.

We also used the Human Development Index for the year 2011 (United Nations Development Programme, 2011) as a country-level predictor of climate change societal risk perception. The Human Development Index is a well-established indicator that gauges life expectancy at birth, educational attainment, and Gross National Income per capita within a single statistic, and it has been widely used in previous research in order to assess a country's socioeconomic context (Lee et al., 2015). Using the Human Development Index as a covariate allows us to rule out that the socioeconomic context is responsible for climate change risk perception, and not CO₂ emissions.

2.3. Statistical analysis

Since the data have a clustered structure with individuals nested within countries, multilevel modelling was used. This method allows to control for individual-level covariates and to assess the hypothesized effects over and above these variables. Furthermore, testing whether a significant mediation has occurred by conducting a country-level analysis is likely to yield a biased indirect effect and very high Type-I error rates (Zhang et al., 2009), because between-country and within-country effects are not fully separated, but combined into a single estimate of the indirect effect. By employing the most recent developments in multilevel mediation analyses, we will apply a more thorough test to the mediation model proposed by Lima and colleagues (2005), and will be able to draw conclusions on the robustness of climate change awareness of causes as a mediator.

For this purpose, we conducted a mediation analysis within the multilevel structural equation modelling framework (Preacher et al., 2011). This provides unbiased estimates of the between-cluster indirect effect by treating the cluster-level component of the individual-level variable as latent. We will provide a schematic illustration of the multilevel mediation model within the structural equation modelling paradigm, when reporting results. Hence, we created a 2-1-1 multilevel mediation model, meaning that the independent variable (X_i) is assessed at country-level, while both the mediators (M_{ij}) and the dependent variable are measured at individual-level (Y_{ij})⁽⁴⁵⁾. In other words, we expected that CO₂ emissions as a country-level antecedent would influence the individual-level mediator (climate change awareness of causes), which would then affect the individual-level outcome variable of climate change risk perception.

Similar to mediation in single-level data, we conducted the mediation analyses in three steps (Zhang et al., 2009). Step 1 showed whether there was a significant association between the independent and dependent variable (also called total effect in the mediation model); step 2 tested whether the independent variable predicted the mediator variable at the between-country level; and step 3 showed whether the mediator affected the dependent variable at the individual- and country-level, when the independent variable was also included as a predictor. The final step allowed us to evaluate the indirect effect, which indicates whether a significant mediation has occurred.

We also examined whether the country-level effects hold, when adjusting for relevant individual-level covariates (e.g., age, education).

Since data were missing on some individual-level variables for some countries, considerably reducing the sample size to 37,382, our modelling strategy consisted of assessing the simpler mediation first, and then testing its robustness when adding individual-level covariates.

To assess whether the mediation model holds for individuals who score low or high on environmental concern, we repeated the mediation analyses with responses from individuals that fall into the 25th percentile (low environmental concern) and 75th percentile (high environmental concern).

We used the Mplus 7.3 software (Muthén and Muthén, 2010) for our analyses, and employed grand-mean centring in all individual-level and country-level variables. We also used a weight variable in all analyses, as provided by the ISSP, which serves to compensate for unequal selection probabilities introduced by sampling design or non-response.

3. Results

Descriptive statistics of all individual-level variables as well as sample characteristics per country are shown in Table 1. Pearson correlation coefficients show that all variables in the mediation model significantly correlate with each other at the country-level in the hypothesized direction. Most importantly, prevalence of CO₂ emissions correlates with climate change risk perception at $r(31) = -0.40$, $p < 0.05$. The negative association indicates a societal risk normalization effect, i.e. the greater the emissions of CO₂ in a country, the smaller the belief that climate change constitutes a risk for the environment. Fig. 1 shows this relationship across ISSP countries. Western and highly industrialised countries (e.g., United States, Norway, and Canada) cluster together at the lower end of the slope, whereas less industrialised countries (e.g., Philippines, Mexico, Turkey) tend to cluster at the higher end.¹ As expected, there was a significant positive correlation between CO₂ emissions and Human Development Index, $r(31) = 0.46$, $p < 0.01$ (United Nations Development Programme, 2011). We also found a strong country-level correlation between climate change awareness and climate change risk perception, $r(17) = -0.65$, $p < 0.01$ as well as CO₂ emissions and climate change awareness, $r(16) = 0.60$, $p < 0.05$. Thus, we proceeded to test climate change awareness of causes as the mediator for the link between CO₂ emissions and climate change risk perception.

3.1. Mediation model

The intra-class correlation coefficient (ICC) from the multilevel analyses indicated that 8.20% of the total variance in climate change risk perception — and an even higher proportion of the total variance in climate change awareness of causes (11.90%) — were associated with differences between-countries. As expected, step 1 of the mediation analysis showed that respondents reported less climate change risk perception if they resided in countries with more CO₂ emissions than in countries with fewer emissions, $B = -0.035$, $SE = 0.011$, $p < 0.01$. We found no evidence that the Human Development Index was predictive of the criterion variable over and above CO₂ emissions ($B_{\text{HumanDevelopmentIndex}} = -0.0002$, $SE = 0.003$, $p = 0.0578$; $B_{\text{CO}_2} = -0.031$, $SE = 0.014$, $p = 0.030$). This suggests that socioeconomic context does not explain country differences in climate change risk perception. Hence, this covariate was dropped from subsequent models, and a maximum degree of freedom was preserved at the country-level. In step 2, we found that more CO₂ emissions predicted higher levels of climate change awareness, $B = 0.053$, $SE = 0.018$, $p < 0.01$. Step 3 showed that greater climate change awareness was associated with

¹ Additional analyses were made to control if specific countries that are unique in their CO₂ emissions and climate change norms, such as USA and Canada, could be driving this relationship. The correlation remained significant when excluding the USA, $r(30) = -0.357$, $p < 0.05$, or the USA and Canada, $r(29) = -0.377$, $p < 0.05$.

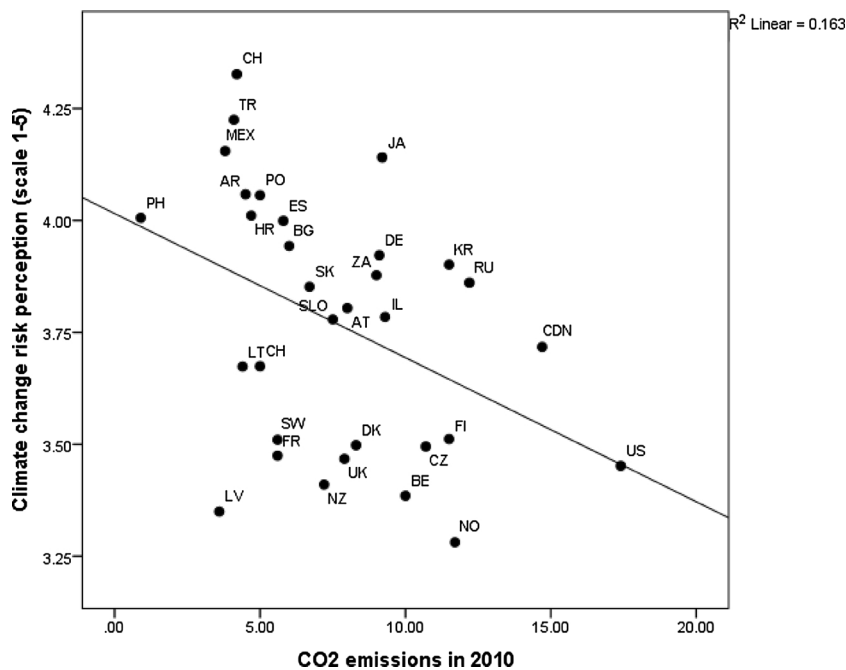


Fig. 1. Scatter plot and best fitting regression line showing average climate change risk perception scores in ISSP countries^a as a function of CO₂ emissions.

^a Argentina(AR), Austria(AT), Belgium(BE), Bulgaria(BG), Canada(CDN), Chile(CH), Taiwan(TW), Croatia(HR), Czech Republic(CZ), Denmark(DK), Finland(FI), France(FR), Germany(DE), Israel(IL), Japan(JA), South Korea(KR), Latvia(LV), Lithuania(LT), Mexico(MEX), New Zealand(NZ), Norway(NO), Philippines(PH), Portugal(PO), Russia(RU), Slovak republic(SK), Slovenia(SLO), South Africa(ZA), Spain(ES), Sweden(SW), Switzerland(CH), Turkey(TR), UK(UK), United States(US).

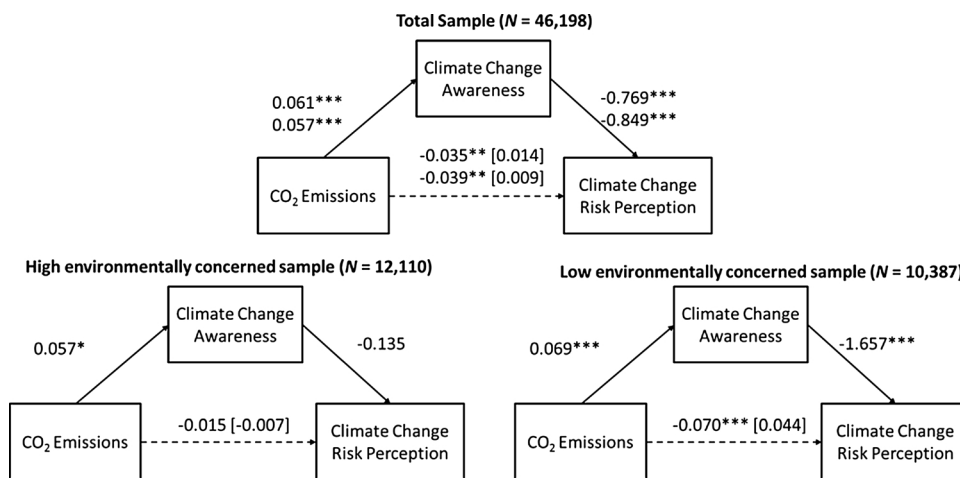


Fig. 2. Multilevel mediation model (2-1-1) showing the country-level associations between CO₂ emissions and climate change risk perception as mediated by climate change awareness (third step of the mediation analyses)^a.

^a Regression coefficients are unstandardized and those in brackets are after including the mediator, whereas those in the second line for the total sample are after controlling for individual-level covariates. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (all two-tailed).

lower levels of climate change risk perception at the country-level, $B = -0.769$, $SE = 0.207$, $p < 0.001$. When climate change awareness was added as a mediator to the model, the effect of CO₂ emissions on climate change risk perception was no longer significant, $B = 0.014$, $SE = 0.023$, $p = 0.547$. The results of the mediation analysis are shown in Fig. 2. The test of the indirect effect corroborated that the effect of CO₂ emissions decreased significantly after taking into account climate change awareness of causes, $B = -0.047$, $SE = 0.020$, 95% CI [-0.086, -0.007]². The significance of country-level effects remained unchanged after controlling for gender ($B = 0.114$, $SE = 0.018$, $p < 0.001$), age ($B = -0.03$, $SE = 0.001$, $p < 0.001$), education ($B = 0.010$, $SE = 0.004$, $p < 0.01$), political orientation ($B = -0.107$,

$SE = 0.021$, $p < 0.001$), and place of living ($B = -0.042$, $SE = 0.007$, $p < 0.001$), in the prediction of environmental risk perception (see also Fig. 2). Most importantly, the indirect effect also remained significant, $B = -0.049$, $SE = 0.016$, 95% CI [-0.081, -0.017], after controlling for these individual-level covariates. Consistent with previous research, women and individuals who had a left-wing political orientation demonstrated higher climate change risk perception (van der Linden, 2015). Furthermore, in line with some research, we found that younger (Milfont, 2012) and more educated people (van der Linden, 2015) have higher climate change risk perception. Regarding place of living, the results confirm the prediction that individuals living in urban areas have higher climate change risk perception than those living in rural areas. These results allow for a better understanding of the relations between societal climate change risk perception and socio-demographics in a more heterogeneous sample of countries, as most research is usually conducted in western industrialised countries.

3.2. Moderation of the mediation model by environmental concern

We repeated the mediation model in two separate samples, i.e., a sample of respondents who scored low on the environmental concern

² To check the robustness of the analyses, we re-ran the mediation analyses without the USA. The results were virtually unchanged: CO₂ emissions predicted climate change risk perception at the country-level, $B = -0.034$, $SE = 0.015$, $p < 0.05$. When climate change awareness was added as a mediator to the model, the effect of CO₂ emissions on climate change risk perception was no longer significant, $B = 0.015$, $SE = 0.024$, $p = 0.522$. The test of the indirect effect corroborated that the effect of CO₂ emissions decreased significantly after taking into account climate change awareness, $B = -0.047$, $SE = 0.020$, 95% CI [-0.086, -0.007]. The full results can be obtained from the authors.

variable (25th percentile, $N = 10,383$), and a sample that scored high on this variable (75th percentile, $N = 12,110$). The ICCs indicated that the proportion of variance in climate change risk perception explained by between-country differences was much higher in the low-scoring sample (18.00%), compared to the high environmentally concerned sample (5.10%). The ICC in climate change awareness was of similar magnitude in both samples ($ICC_{lowenvironmentalconcern} = 12.90\%$; $ICC_{highenvironmentalconcern} = 12.50\%$). Thus, country differences were especially pronounced regarding climate change risk perceptions in the sample with low environmental concern.

The first step of the mediation analysis for the low environmental concern sample corroborated the risk normalization effect, $B = -0.070$, $SE = 0.018$, $p < 0.001$. In step 2, as was previously also the case, we found a positive and highly significant association between CO₂ emissions and climate change awareness, $B = 0.062$, $SE = 0.017$, $p < 0.001$. Step 3 once again showed that greater climate change awareness was associated with lower levels of climate change risk perception at the country-level, $B = -1.657$, $SE = 0.179$, $p < 0.001$. Adding climate change awareness as a mediator rendered the link between CO₂ emissions and climate change risk perception non-significant, $B = 0.044$, $SE = 0.027$, $p = 0.097$. The indirect effect indicated a highly significant mediation, $B = -0.114$, $SE = 0.027$, 95% CI [-0.168, -0.061].

Regarding the high environmental concern sample, we found no evidence for the risk normalization effect, given that the association between CO₂ emissions and climate change risk perception was non-significant, $B = -0.015$, $SE = 0.011$, $p = 0.163$. Nonetheless, considering that a significant association between independent and criterion variable is not a prerequisite for a mediation analysis (Rucker et al., 2011), we proceeded to test our model. Step 2 showed a positive association between CO₂ emissions and climate change awareness, $B = 0.054$, $SE = 0.021$, $p < 0.05$, which is consistent with the findings we have reported above. However, step 3 showed that climate change awareness was not significantly related to climate change risk perception at the country-level, $B = -0.135$, $SE = 0.128$, $p = 0.292$. The indirect effect was non-significant, $B = -0.008$, $SE = 0.009$, 95% CI [-0.025, 0.010], indicating that climate change awareness did not act as a mediator for the CO₂ risk perception association. The results of the mediation analysis are also shown in Fig. 2.

In sum, these results show that the process of risk normalization, wherein individuals more exposed and aware of risk minimize their risk perception, occurs for individuals with low concern about the environment. Yet, individuals who are highly environmentally concerned are not prone to the risk normalization effect.

4. Discussion

4.1. Main findings

This study provides cross-national evidence for the occurrence of a societal risk perception of climate change normalization effect using multilevel analyses on more recent data. Results showed that higher emissions of CO₂ related to lower societal risk perception of climate change, due to higher awareness of climate change causes. The societal risk perception normalization effect of climate change held, while controlling for gender, age, education, political orientation, and place of living. This suggests that the effect is fairly robust and is unaffected by compositional effects. As expected, we found that it was moderated by individuals' environmental concern. Those who were ideologically motivated to think, feel, and act in a more environmentally concerned way were more resilient to risk perception normalization.

In literature, there is mixed evidence for the relation between awareness and risk perception, with most studies suggesting a positive relation. However, in this study we found a negative relation between awareness and risk perception, such as in the study by Lima and colleagues (2005), using a large sample that covered different countries. It

might be that climate change risk normalization effects are more likely when we focus on the relation between knowledge of causes and societal risk. As Tobler et al., 2012, different aspects of climate change-related knowledge appear to be differently related to psychological variables.

4.2. Limitations

When interpreting these findings, there are some limitations to consider. First, due to the nature and characteristics of the study, the process of risk normalization is inferred from the data, as well as the coping strategies individuals might have used. Nonetheless, we believe that the trade-off between this limitation and the cross-national nature of the study is positive.

Second, the cross-sectional nature of the evidence constrains interpretation of cause and effect. Yet it seems reasonable to assume that the CO₂ emission macro-variable might not be primarily caused by individuals' climate change awareness and/or climate change risk perception, but by a host of macroeconomic factors, such as the technological development of a country and its economic growth. In this way, the cause and effect question might be predominantly about the association between climate change awareness and climate change risk perception. We examined an alternative model by using the total sample, in which individual-level covariates were included and the mediator and outcome variable were interchanged (i.e., climate change awareness became the dependent variable and climate change risk perception the mediating variable). The indirect effect was still significant, $B = 0.019$, $SE = 0.008$, 95% CI [0.003, 0.035]. Moreover, CO₂ emissions were predictive of climate change risk awareness, $B = -0.033$, $SE = 0.012$, $p = 0.007$, and climate change risk perception predicted awareness, $B = -0.582$, $SE = 0.139$, $p < 0.001$. However, the link between the independent and dependent variable, i.e. CO₂ emissions and awareness, also remained highly significant, $B = 0.042$, $SE = 0.012$, $p < 0.001$, and was not reduced to non-significance (which would indicate a full mediation as in our originally specified mediation model). In sum, this alternative model shows that CO₂ emissions still have an effect on awareness of climate change causes when controlling for risk perception of climate change which suggests that the originally hypothesized model has more explanatory value (due to the full mediation result). Nevertheless, the possibility that climate change risk perceptions also affect the extent to which people are aware about the environment remains very plausible. For instance, it might be that individuals who perceive greater environmental risks become more aware of what causes climate change because risk perception motivates them to actively seek more information about climate change.

Third, as with most major social surveys, our mediator and outcome variables were each measured by single items. On one hand, this might be problematic because multidimensional measures of climate change knowledge lead to more informative predictions about climate change risk perceptions (Shi et al., 2016; van der Linden, 2015). On the other hand, the use of those measures might have allowed for the risk normalization process to emerge. In this vein, a future avenue would be to explore how the dimensions of climate change awareness (e.g., causes, effects, measures) might relate to psychosocial processes that differently explain the relation between awareness and risk perception (e.g., normalization, ideologically motivated reasoning, heuristic-driven processing). It should also be noted that items included in the ISSP meet the highest methodological standards in survey research to ensure reliability and validity. They are pilot tested extensively for construct validity. Moreover, the methodological work in the ISSP is coordinated by a Methodology Committee that is specifically concerned with cross-cultural equivalence. This bolsters confidence that the items are good indicators of societal climate change risk perception and awareness of climate change causes.

4.3. Implications and conclusion

Raising public awareness about climate change is often assumed as one of the key factors in order to transform society and, therefore, promote mitigation and adaptation to climate change (IPCC, 2014). Awareness is necessary, as people need to be knowledgeable to make informed decisions. However, information-deficit approaches that assume that a lack of information about the causes of global warming is the primary reason for inaction do not explain why the people that are knowledgeable do not perceive and act accordingly (e.g., Luís et al., 2016; Norgaard, 2006).

The negative relation between awareness of climate change causes in countries with high CO₂ emissions and risk perception is explained by referring to cognitive adaptation strategies that allow for a perceived threat to be diminished, although we have no data on the strategies individuals use to normalize risk. Denial has been highlighted as a strategy that explains how people fail to act on their climate change knowledge. For instance, Norgaard's (2006) study on a rural Norwegian community illustrates that people collectively held information about global warming at arm's length by following cultural norms (such as focusing on the local/present and being optimistic) or by using a series of interpretive narratives to deflect disturbing information and normalize a particular version of reality in which there are no threats. As she states, "people were aware of the causes of global warming, had access to information which they accepted as accurate, yet for a variety of reasons they chose to ignore it. This was a paradox." (2006, p. 350). We found convergent paradoxical results on a larger scale. Furthermore, we found that this effect was dependent on the countries' CO₂ emissions, being shared at a country-level. Risk normalization was more likely in countries with higher CO₂ emissions, that is, in countries where the threat posed by climate change was higher. It is possible that in some countries the normalization of societal risk perception of climate change is justified, as adequate mitigation and adaptation policymaking is being put into motion. However, the fact is that, despite the increase in commitment to climate change mitigation in many countries (Burck et al., 2015), global CO₂ emissions continued to grow (Friedlingstein et al., 2014).

It is important to comprehend and mitigate risk normalization. This study suggests that a way to mitigate the normalization of climate change risk perception is to promote environmental concern, considering that this normalization effect did not emerge when individuals had high environmental concern. Challengingly, environmental concern has been slightly decreasing in various countries, over the last decades being important to reverse this trend (Franzen and Vogl, 2013). In this vein, it is also important to highlight some strategies that might minimize climate change denial in particular, such as increasing the connectedness of children to nature (Louv, 2008) and shifting from anthropogenic to ecocentric worldviews (Washington et al., 2017). Recent studies further suggest the importance of explaining argumentative techniques to minimize misinformation on climate change (e.g., Cook et al., 2017).

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